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1. A functionalized nanocrystal-labeled nucleobase comprising a functionalized nanocrystal operably linked to a nucleobase; and wherein the functionalized nanocrystal comprises one or more reactive functionalities, and the nucleobase comprises one or more reactive functionalities, which are used to operably link the functionalized nanocrystal to the nucleobase.

2. The functionalized nanocrystal-labeled nucleobase according to claim 1, further comprising a linker which operably links the functionalized nanocrystal to the nucleobase.

3. The functionalized nanocrystal-labeled nucleobase according to claim 1, wherein the one more reactive functionalities is selected from the group consisting of an amino group, a thiol group, an amino reactive group, a thiol reactive group, a carboxyl-reactive group, a carboxyl group, and a combination thereof.

4. The functionalized nanocrystal-labeled nucleobase according to claim 1, wherein the functionalized nanocrystal is capped with a capping compound comprising a mercaptofunctionalized amine, wherein the functionalized nanocrystal further comprises at least one additional coating comprising one or more reactive functionalities, and wherein the at least one additional coating is selected from the group consisting of maleimide derivative, and amino acid.

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5. The functionalized nanocrystal-labeled nucleobase according to claim 4, wherein the least one additional coating comprises an amino acid, and wherein the amino acid comprises diaminocarboxylic acid.

6. The functionalized nanocrystal-labeled nucleobase according to claim 1, wherein the functionalized nanocrystal is capped with a capping compound comprising a mercaptocarboxylic acid, wherein the functionalized nanocrystal further comprises at least one additional coating comprising one or more reactive functionalities, and wherein the at least one additional coating comprises amino acid.

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7. The functionalized nanocrystal-labeled nucleobase according to claim 6, wherein the amino acid comprises diaminocarboxylic acid.

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8. A kit comprising a plurality of species of functionalized nanocrystal-labeled nucleobases, wherein an amount of each species of functionalized nanocrystal-labeled nucleobase is separately packaged, wherein each species of functionalized nanocrystal-labeled nucleobase comprises a different nucleobase type than the nucleobase type of the other species of the plurality of species of functionalized nanocrystal-labeled nucleobases, and wherein each species of functionalized nanocrystal-labeled nucleobase is differentially labeled with a species of functionalized nanocrystal that can emit a fluorescence emission that is spectrally resolvable as compared to the species of

functionalized nanocrystals used to label the other species of the plurality of species of functionalized nanocrystal-labeled nucleobases.

b 7 9. The kit according to claim ~~8~~⁶, wherein the nucleobase type include in the kit is selected from the group consisting of deoxynucleotides, chain-terminating nucleobases, and a combination thereof.

8 10. A kit comprising, in separate packaging: an amount of a functionalized nanocrystal having one or more reactive functionalities; and an amount of a nucleobase having one or more reactive functionalities.

9 11. The kit according to claim ~~10~~⁸, wherein the one more reactive functionalities is selected from the group consisting of an amino group, a thiol group, an amino reactive group, a thiol reactive group, a carboxyl-reactive group, a carboxyl group, and a combination thereof.

10 12. The kit according to claim ~~10~~⁸, further comprising a linker which can be used to operably link the functionalized nanocrystal to the nucleobase.

11 13. A method of using the functionalized nanocrystal-labeled nucleobase according to claim ~~7~~¹¹ in a process comprising strand synthesis, the method comprising adding at least one species of functionalized nanocrystal-labeled nucleobase to a strand synthesis reaction, wherein the at least one

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species of functionalized nanocrystal-labeled nucleobase is incorporated into a strand synthesized in the reaction.

b 12 14. The method according to claim 13, wherein the at least one functionalized nanocrystal-labeled nucleobase comprises a plurality of species of functionalized nanocrystal-labeled nucleobases, and wherein each species can emit a fluorescence emission that can be spectrally resolved from the fluorescence emission that can be emitted by other species of the plurality of species of functionalized nanocrystal-labeled nucleobases.

allowed 13 15. The method according to claim 14, wherein each species of functionalized nanocrystal-labeled nucleobase comprises a different nucleobase type than the nucleobase type of the other species of the plurality of species of functionalized nanocrystal-labeled nucleobases.

b 14 16. The method according to claim 15, wherein the nucleobase type is selected from the group consisting of deoxynucleotides, chain-terminating nucleobases, and a combination thereof.

b 15 17. The method according to claim 14, further comprising separating the synthesized strands resulting from the strand synthesis by a parameter selected from the group consisting of time, space, length, size, and a combination thereof.

b 16 18. The method according to claim 17, further comprising exposing the synthesized strands to an excitation light

source in exciting functionalized nanocrystals, of incorporated functionalized nanocrystal labeled nucleobases, to emit a fluorescence emission.

b 17 19. The method according to claim 18, wherein the excitation light is in the spectral range of from about 300 nanometers to about 400 nanometers.

b 18 20. The method according to claim 18, wherein fluorescence emission emitted from the species of functionalized nanocrystals comprise spectrally resolvable fluorescence peaks in the spectral range of from about 400 nanometers to about 750 nanometers.

allowed 19 21. The method of claim 20, further comprising detecting the spectrally resolvable fluorescence peaks by a detection means which can detect and distinguish between discrete fluorescence peaks in the spectral range of from about 400 nanometers to about 750 nanometers.

20 22. The method according to claim 21, further comprising relating the fluorescence emission peaks and their intensity of fluorescence to determine the identities and positions of the types of nucleobases incorporated as functionalized nanocrystal-labeled nucleobases into the synthesized strands.

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